# Empirically inferring transient climate sensitivity from historical warming

Yi Ming[1]

[1] *Geophysical Fluid Dynamics Laboratory/NOAA, Princeton, New Jersey 08540-6649, USA*

**The Earth's surface temperature has risen by about 0.8 K over the last 100 years partly due to human activities[1,2]. If not for the poorly understood radiative effects of aerosols, one would have been able to better use the observed warming to constrain the all-important transient climate sensitivity (TCS, the pace of the warming caused by a continuous buildup of greenhouse gases)[3]. Here we show that it is feasible to infer the historical aerosol forcing and subsequently TCS from the surface temperature record by exploiting the seasonality difference between the aerosol and greenhouse gas forcings. Our analysis suggests that the seasonally-varying aerosol forcing played a crucial role in causing the Northern Hemisphere (NH) winter to warm at a faster pace than the NH summer – a distinct feature of the observed warming. The estimated 25% to 75% range is -1.7 – -0.7 W m$^{-2}$ for the aerosol forcing, and is 0.9 – 1.7 K (at the time of $CO_2$ doubling) for TCS. The respective 5% to 95% ranges are -2.5 – 0.1 W m$^{-2}$ and 0.7 – 3.8 K. The median TCS of 1.3 K is considerably smaller than those projected with state-of-the-art climate models[4] or derived in attribution studies[5–11]. The results are highly relevant to shaping the climate outlook for the coming decades.**

As the near-term climate change is strongly tied to TCS, the inability of climate models to converge on TCS hinders a reliable projection of future climate. (In this work, TCS is defined